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PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant:	Tetsuya Mizusugi et al	Examiner:	J. Woodard
Serial No:	08/204,536	Group Art Unit:	1303
Filed :	March 2, 1994	Docket:	8373.52US01
Title :	METHOD OF BENDING SHEET GLASS		

DECLARATION UNDER 37 C.F.R. SECTION 1.131

Assistant Commissioner for Patents
Washington, D. C. 20231

Sir:

I am the Japanese patent agent for the Applicant of the patent application corresponding to the above-mentioned case.

I hereby declare that the enclosed translation of the certificate of the certified Japanese priority document, Application No. 5-41203, filed March 2, 1993 is all true, and that the priority date of the above-identified U.S. patent application is March 2, 1993.

I hereby request that the effective filing date of the above-identified U.S. patent application swear back to the Japanese priority date March 2, 1993 under 37 C.F.R. §1.131.

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or

imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

October 24, 1995
DATE

Kunihiko Ohashi
PRINTED NAME

SIGNATURE

PATENT OFFICE

JAPANESE GOVERNMENT

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application: March 2, 1993

Application Number : Patent Appln. No. 5-041203

Applicant(s) : NIPPON SHEET GLASS CO., LTD.

(SEAL)

Dated: March 11, 1994

Commissioner,
Patent Office **Wataru Aso**

TRANSLATION CERTIFICATE

I, the below named verifier, hereby certify that:

(1) My name and post office address are as stated below;

(2) I am knowledgeable in the English language and in the language in which the below identified Japanese Application was filed; and that

(3) I believe the attached is a full, true and faithful translation into the English language of the

[X] Application for Patent

[X] Specification

[X] Claim(s)

[X] Abstract

[X] Drawing

of Japanese Patent application No.5-041203, filed March 2, 1993.

I declare further that all statements made herein on personal knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

signed this 20 day of October, 1995.

Full name of verifier Yoshio Aoyagi

Signature of verifier Yoshio Aoyagi

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[Document Name] Application for Patent

[Reference No.] NSG9311

[Filing Date] March 2, 1993

[Addressee] Commissioner, Patent Office

[IPC] C03B 23/023
C03B 35/14

[Title] Sheet glass bending method

[No. of Claim(s)] 1

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[Indication of Fees]

[Manner of Payment] Deposit

[Deposit Ledger No.] 004466

[Amount Paid] 14000

[List of Attached Documents]

[Document Name] Specification 1

[Document Name] Drawings 1

[Document Name] Abstract 1

[General Power No.] 9002119

[Name of Document] Specification

[Title of the Invention]

Sheet glass bending method

[Claim]

[Claim 1] A sheet glass bending method of bending a sheet glass, which has been heated up to a temperature near its softening point, into a configuration in conformity with a mold surface shape by sucking said sheet glass onto the surface of a suction bending mold, characterized in that the interior of said suction bending mold is divided into a plurality of suction chambers, and the timings of suction made by said suction chambers are shifted from one another for gradually bending said sheet glass from a particular portion to another portion in order.

[Detailed Description of the Invention]

[Industrial Field to be Applied]

The present invention relates to a method of bending a sheet glass by using a suction bending mold.

[Prior Art]

In Japanese patent laid-open publication No. 62-270429 or No. 62-30136, there is disclosed a method of bending a sheet glass, which has been heated up to a temperature near its softening point, into a configuration in conformity with a mold surface shape by sucking the sheet glass onto the surface of a suction bending mold.

With the former publication, the suction bending mold (of convex type) is disposed inside a furnace, and the heated

sheet glass is floated with the aid of air and pressed against the bending surface of the suction bending mold under suction, thereby bending the sheet glass. With the latter publication, the heated glass is lifted by a ring mold and pressed against the bending surface of the suction bending mold under suction, thereby bending the sheet glass.

In the above-mentioned prior art, adhesion forces may be lowered because of a large amount of air flowing in through suction holes of the bending mold which are positioned in portions not contacted with the sheet glass. For eliminating such a disadvantage, therefore, it is proposed in Japanese utility model laid-open publication No. 63-27443 and Japanese patent laid-open publication No. 59-232926 to divide the interior of the bending mold into a plurality of chambers and set suction pressures of the individual chambers to be different from one another.

[Problem to be Solved by the Invention]

The above-mentioned prior art in which the interior of the bending mold is divided into a plurality of chambers, however, also has the disadvantages illustrated in Fig. 8 or 9 because the plurality of chambers are operated to start suction at the same time.

More specifically, Fig. 8(a) shows a state before suction in which peripheral edges of a heated sheet glass G is pressed by a ring mold 101 against the surface of a suction bending mold 100 of convex type. When the suction is started under such a state, the air residing between the sheet glass

G and the surface of the bending mold 100 cannot escape therefrom, as shown in Fig. 8(b), whereby reversely curved portions are partly formed and a reflecting distortion is worsened.

Also, Fig. 9(a) shows a state before suction in which peripheral edges of a heated sheet glass G is pressed by a ring mold 101 against the surface of a suction bending mold 100 of reversal type that the mold surface is partly concaved. When the suction is started under such a state, the sheet glass G may be broken because of being unable to spread properly following the mold surface, as shown in Fig. 9(b).

[Means for Solving the Problem]

To solve the above problem, the present invention is intended for a sheet glass bending method using a suction bending mold, wherein the interior of said suction bending mold is divided into a plurality of suction chambers, and the timings of suction made by said suction chambers are shifted from one another for gradually bending said sheet glass from a particular portion to another portion in order.

[Operation]

With the timings of suction made by the suction chambers shifted from one another, the sheet glass is successively and gradually bent from a central portion or one side portion to another portion thereof.

[Embodiment]

Hereinafter, embodiments of the present invention will be described with reference to the attached drawings. Fig. 1

is an overall view of an apparatus used for practicing a sheet glass bending method according to the present invention, Fig. 2 is a cross-sectional view of a suction bending mold, and Fig. 3 is a plan view of the suction bending mold.

In Fig. 1, denoted by reference numeral 1 is a tunnel-type heating furnace. A bending stage S1 is provided on the downstream side (i.e., the right side in the drawing) of the heating furnace 1, and a quenching stage S2 is provided on the downstream side of the bending stage S1.

A plurality of conveyor rollers 2... are arranged over a span from the inside of the heating furnace 1 to the bending stage S1. In an upper portion of the bending stage S1, a suction bending mold 3 is disposed which is vertically movable and serves as an upper mold. Below the suction bending mold 3, there is disposed a ring mold 4 which is also vertically movable. Further, in-mold rollers 5 being vertically movable are disposed inwardly of the ring mold 4.

In the quenching stage S2, a pair of quenching boxes 6, 7 for jetting cooling air are disposed to be vertically spaced with a quenching ring 8 provided between the quenching boxes 6 and 7. The quenching ring 8 is reciprocally movable between the bending stage S1 and the quenching stage S2.

The suction bending mold 3 is formed, as shown in Figs. 2 and 3, into a box-like shape having a lower surface as a convex shaping or bending surface 31. A number of suction holes 32 are defined in the bending surface 30, and the interior of the box-shaped mold is divided by partitions 33

into a plurality of suction chambers C1, C2, C3.

Of the above plural suction chambers, the central suction chamber C1 is connected to a vacuum device 36 via a duct 34 and a valve 35, while the chambers C2, C3 on both sides are connected to a vacuum device 39 via a duct 37 and a valve 38 common to both the chambers.

Further, the lower bending surface 31 of the suction bending mold 3 is entirely covered with a surface material 41 fastened to hooks 40 and made of glass cloth or metal cloth, so that tracks of the suction holes 32 will not be transferred onto a sheet glass G when it is bent under suction.

A method of bending the sheet glass G by using the apparatus thus constructed will now be described.

First, the sheet glass G is heated up to a temperature near its softening point while passing through the heating furnace 1 over the conveyor rollers 2. The sheet glass G is then transferred from the conveyor rollers 2 onto the in-mold rollers 5.

After that, the in-mold rollers 5 are lowered for transferring the sheet glass G onto the ring mold 4. In parallel with the lowering of the in-mold rollers 5, the suction bending mold 3 is also lowered. Before the suction bending mold 3 starts lowering, the valves 35, 36 are both opened and no suction forces are applied to the bending surface 31 of the suction bending mold 3. At the same time as when the suction bending mold 3 starts lowering, the valve 35 is closed to reduce a pressure in the central suction chamber C1

so that suction forces are applied to an area of the bending surface 31 corresponding to the central suction chamber C1.

When the suction bending mold 3 continues lowering and comes closer to a final position of the lowering stroke under that condition, i.e., when the bending surface 31 of the suction bending mold 3 approaches the sheet glass G on the ring mold 4, a central portion of the sheet glass G is sucked to the area of the bending surface 31 corresponding to the central suction chamber C1, as shown in Fig. 4.

It is to be noted that while the central portion of the sheet glass G is first sucked when the suction bending mold 3 is of a convex mold as shown, a portion of the sheet glass G corresponding to a recessed bending surface is first sucked when the suction bending mold 3 is of the reversal type.

Then, at the same as when the central portion of the sheet glass G is sucked, the valve 38 is closed to apply suction forces through the suction chambers C2, C3 on both sides as well, so that both side portions of the sheet glass G are sucked by areas of the bending surface 31 corresponding to the suction chambers C2, C3, thereby entirely bending the sheet glass G in conformity with the bending surface 31, as shown in Fig. 5.

After that, the suction bending mold 3 holding the sheet glass G sucked thereto is raised, and the quenching ring 8 is moved to enter the bending stage at a level below the suction bending mold 3 (but above the ring mold 4). The valves 35, 38 are now opened to release the suction forces, whereupon

the sheet glass G is transferred from the suction bending mold 3 onto the quenching ring 8. Subsequently, the quenching ring 8 supporting the sheet glass G is moved to enter between the quenching boxes 6 and 7 in the quenching stage S2, followed which the sheet glass G is quenched, i.e., hardened under quick cooling.

Figs. 6(a) to 6(d) are views showing other embodiments of the suction bending mold. Those molds shown in Figs. 6(a) to 6(c) are each suitable to form a deeply bent product with its upper portion bent into a cap-like shape, as shown in Fig. 7(a). More specifically, the mold shown in Fig. 6(a) has a small chamber C4 defined along the upper side above the central chamber C1. The mold shown in Fig. 6(b) has a small chamber C4 defined to cover the central chamber C1 and the chambers C2, C3 on both sides. The mold shown in Fig. 6(c) has small chambers C4, C5, C6 defined along the upper side, respectively, corresponding to the central chamber C1 and the chambers C2, C3 on both sides.

Also, the mold shown in Fig. 6(d) is suitable to form a bent product of the type shown in Fig. 7(b). More specifically, this mold comprises an upper side chamber C7 and a lower side chamber C8.

It is to be noted while the quenching stage is disposed on the downstream side of the bending stage in the illustrated embodiment, the bending method according to the present invention can be applied to any bending methods so long as the suction bending mold is used therein.

Further, the suction bending mold may be any of a convex mold, a concave mold, an upper mold, a lower mold, and a suspended pressing mold. The suction means may be of a blower, an ejector pump, a vacuum pump, a vacuum tank, or a combination of some thereof. In addition, the suction pressures may be different from one another in the suction chambers.

[Effect of the Invention]

According to the present invention, as described above, in a sheet glass bending method using a suction bending mold of which interior is divided into a plurality of suction chambers, the timings of suction made by the plurality of suction chambers are shifted from one another for successively and gradually bending a sheet glass from a central portion or one side portion to another portion. As a result, a deeply bent product can be formed accurately and smoothly with no fear of that air may not reside between the sheet glass and the bending surface, or that the sheet glass may be cracked because of being unable to properly spread following the bending surface.

[Brief Description of the Drawings]

Fig. 1 is an overall view of an apparatus used for practicing a sheet glass bending method according to the present invention.

Fig. 2 is a cross-sectional view of a suction bending mold.

Fig. 3 is a plan view of the suction bending mold.

Fig. 4 is a cross-sectional view of the suction bending mold showing a condition in the course of bending.

Fig. 5 is a cross-sectional view of the suction bending mold showing a condition in the course of bending.

Figs. 6(a) to 6(d) are plan cross-sectional views showing other embodiments of the suction bending mold.

Figs. 7(a) and 7(b) are each a perspective view of a sheet glass formed by corresponding one(s) of the suction bending molds shown in Fig. 6.

Figs. 8(a) and 8(b) are views showing conventional bending methods and disadvantages thereof.

Figs. 9(a) and 9(b) are views showing conventional bending methods and disadvantages thereof.

[Reference Numerals]

1...heating furnace, 3...suction bending mold, 4...ring mold, 6, 7...quenching box, 8...quenching ring, 31...bending surface, 32...suction hole, 33...partition, C1, C2, C3, C4, C5, C6, C7, C8...suction chamber, G...sheet glass, S1... bending stage, and S2...quenching state.

【書類名】 図面

FIG.1

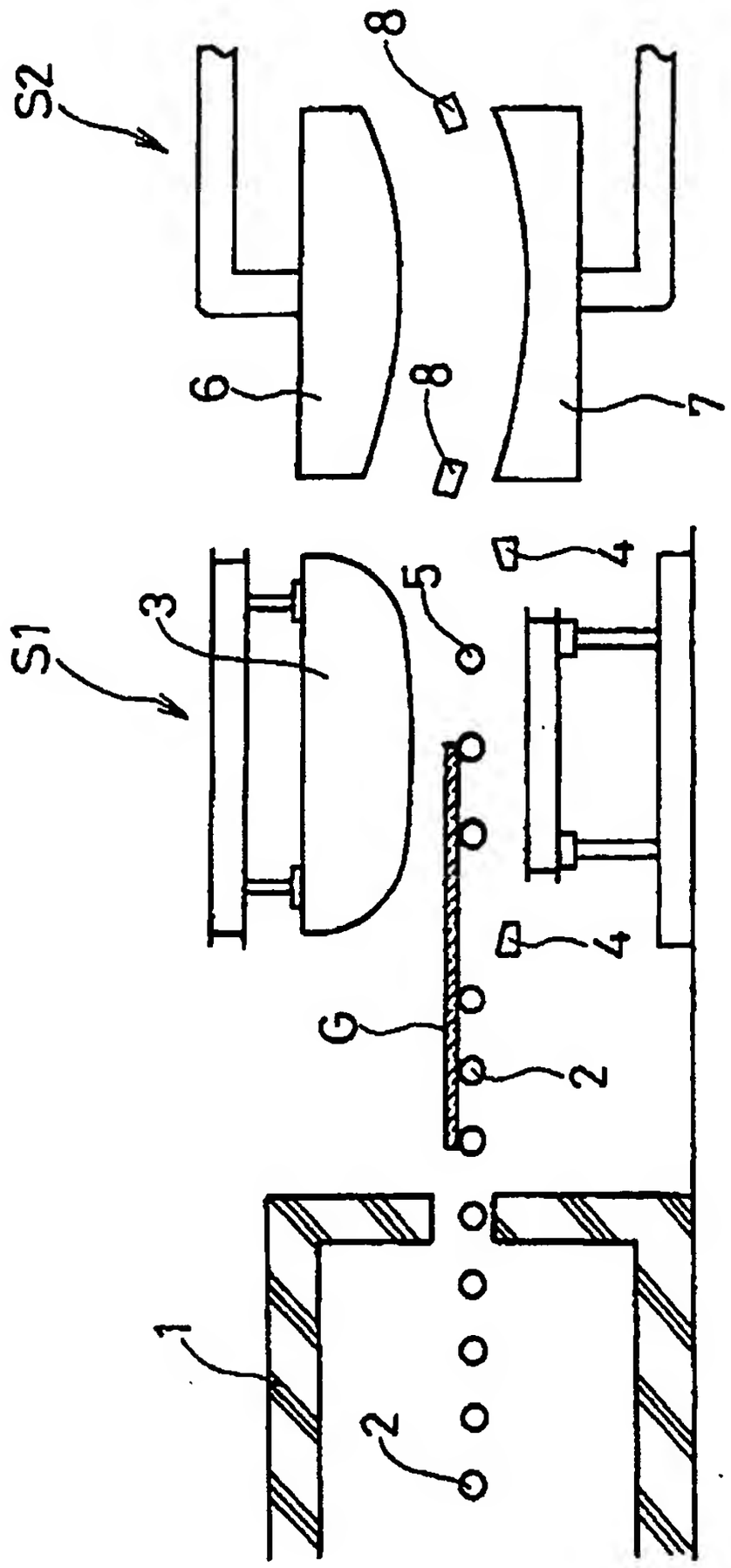


FIG. 2

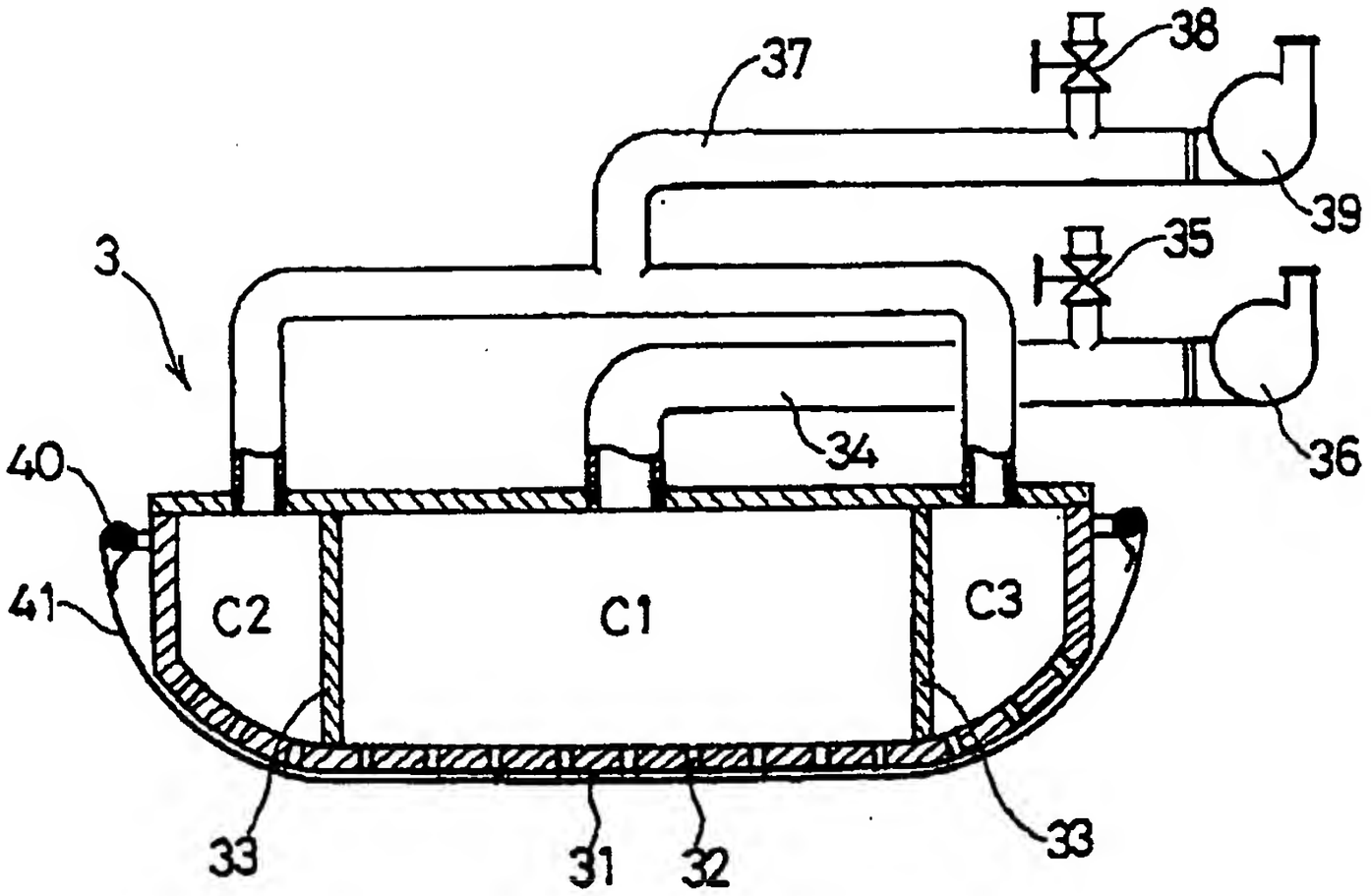
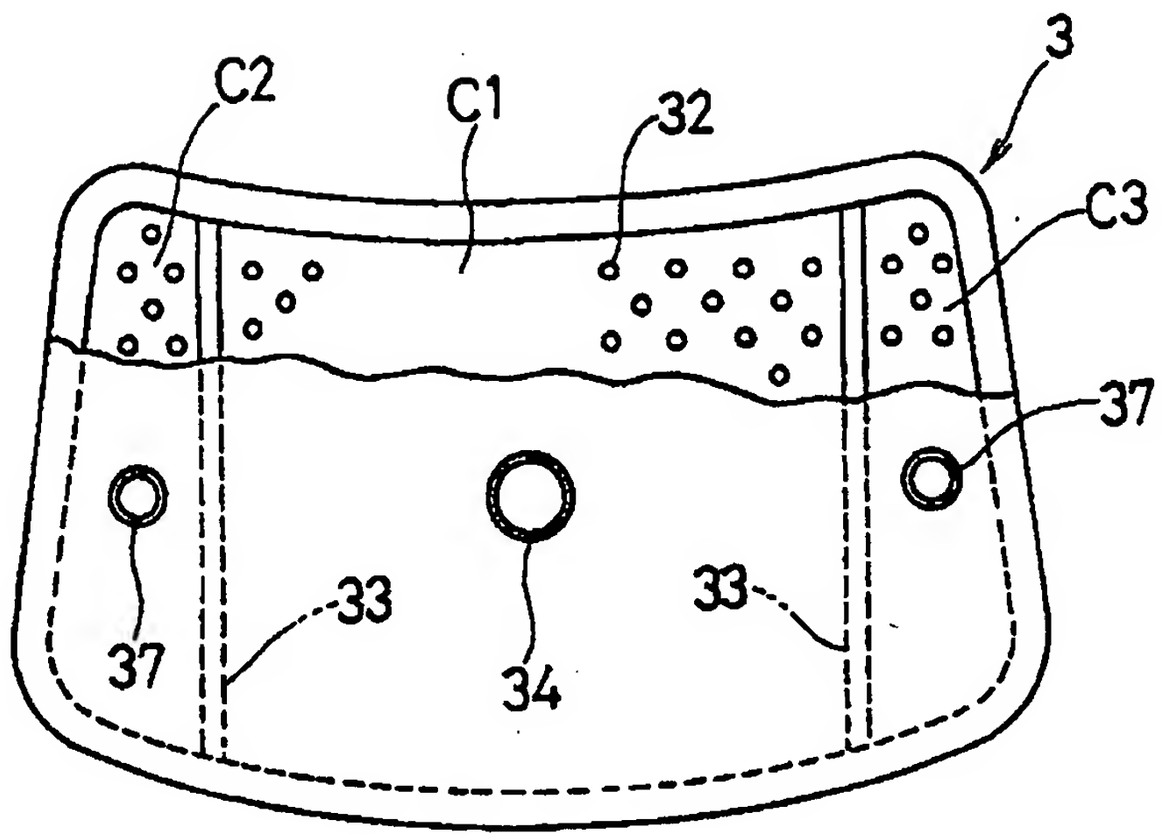


FIG. 3



[Name of Document] Abstract

[Summary]

[Object] An object is to bend a sheet glass by a suction bending mold in such a manner as no to cause cracks or reflection distortions.

[Construction] When a bending surface 31 of a suction bending mold 3 approaches a sheet glass G on a ring mold 4, a central portion of the sheet glass G is sucked to an area of the bending surface 31 corresponding to a central suction chamber C1. Then, a pressure in suction chambers C2, C3 on both sides is reduced so that both side portions of the sheet glass G are sucked by areas of the bending surface 31 corresponding to the suction chambers C2, C3.

[Selected Figure] Fig. 4

FIG. 4

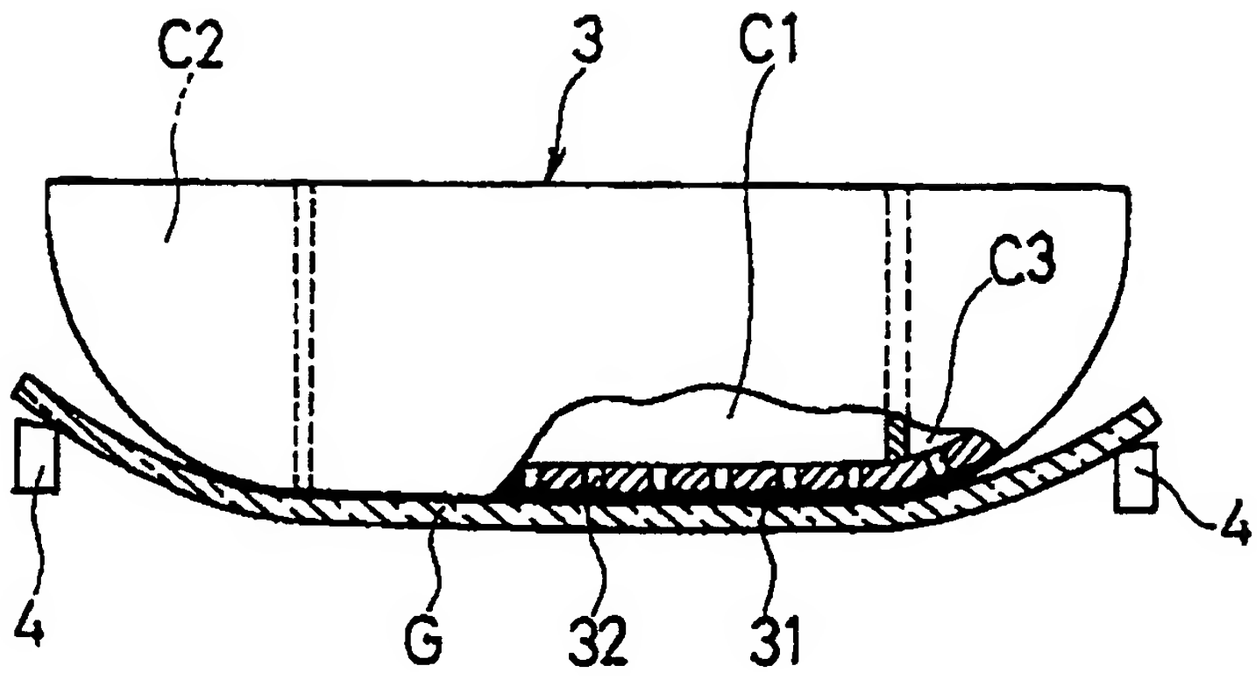


FIG. 5

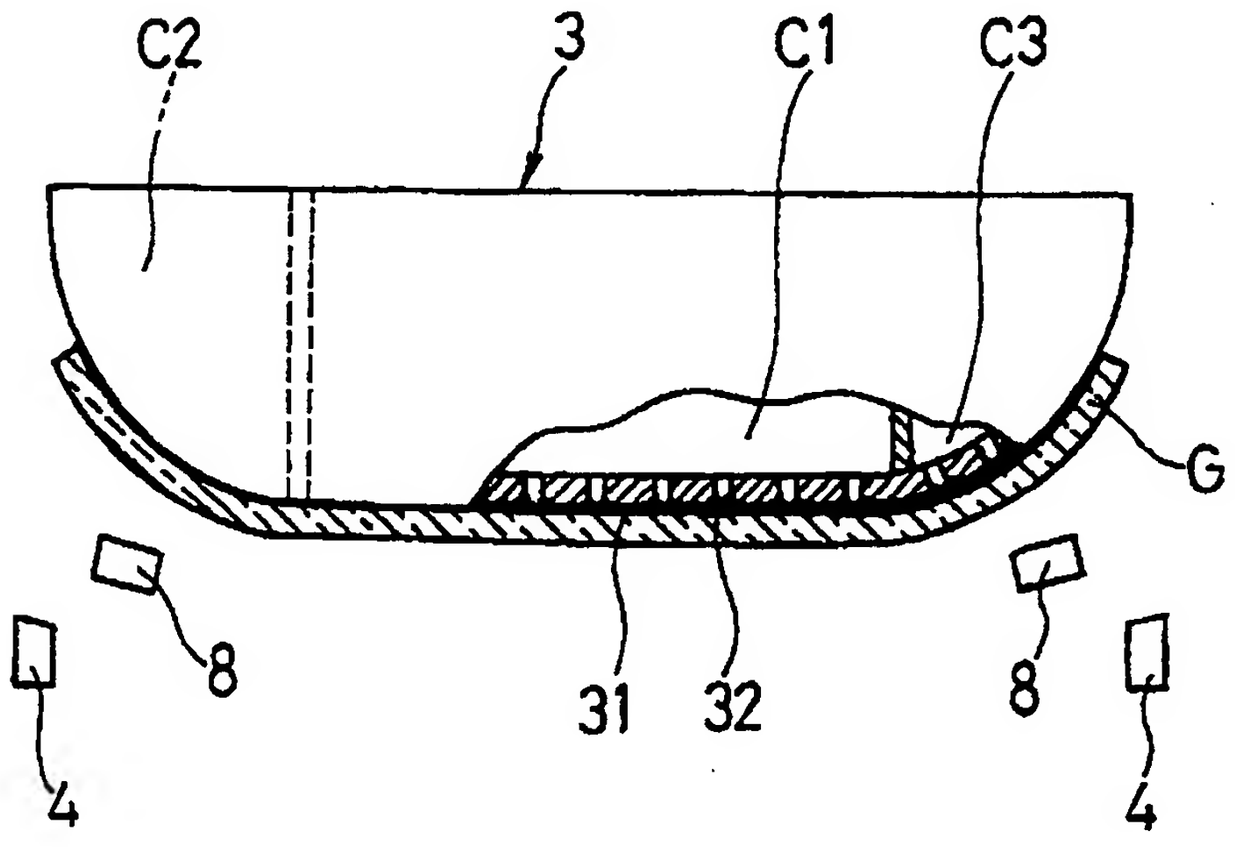


FIG.6

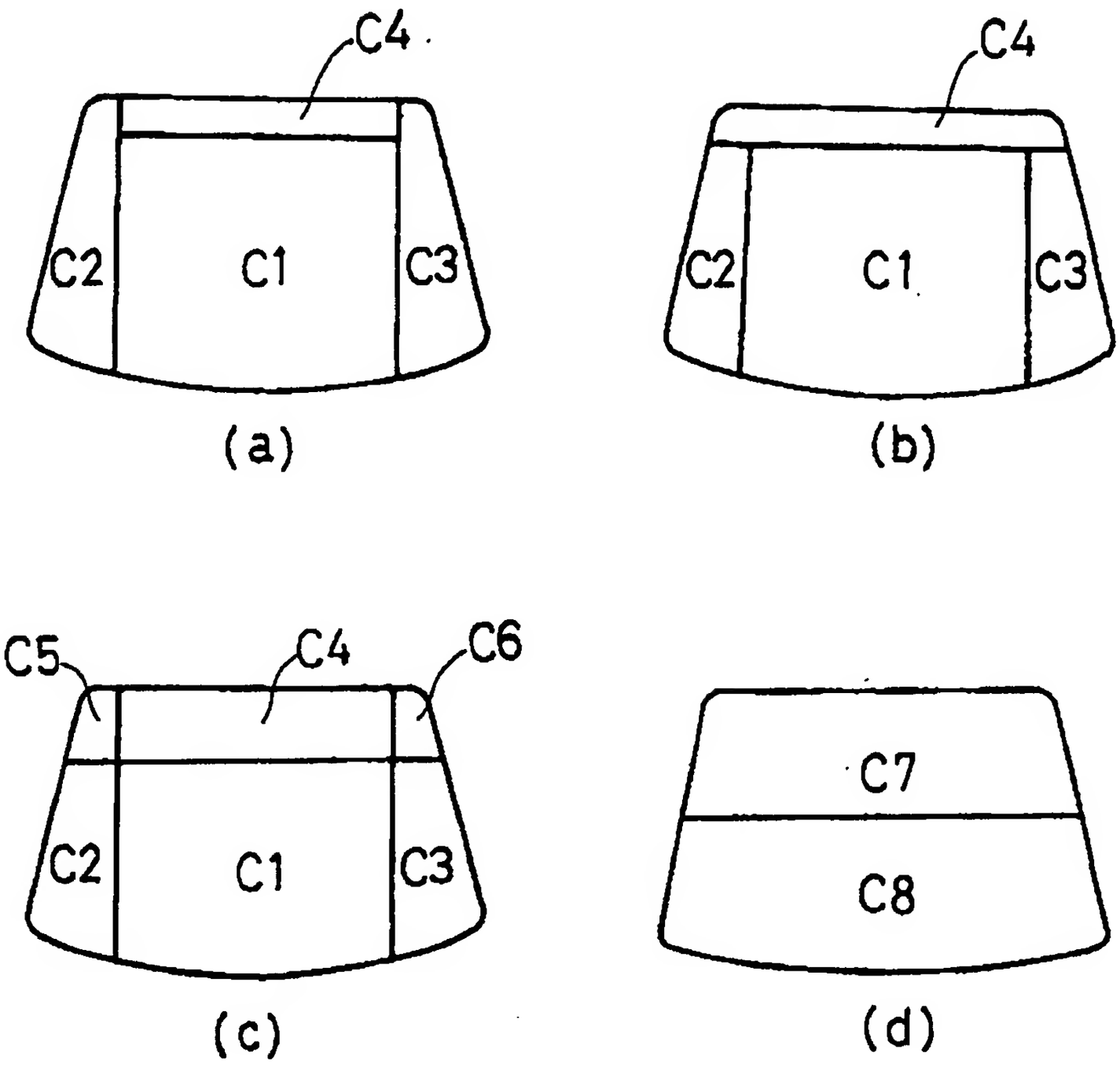


FIG.7

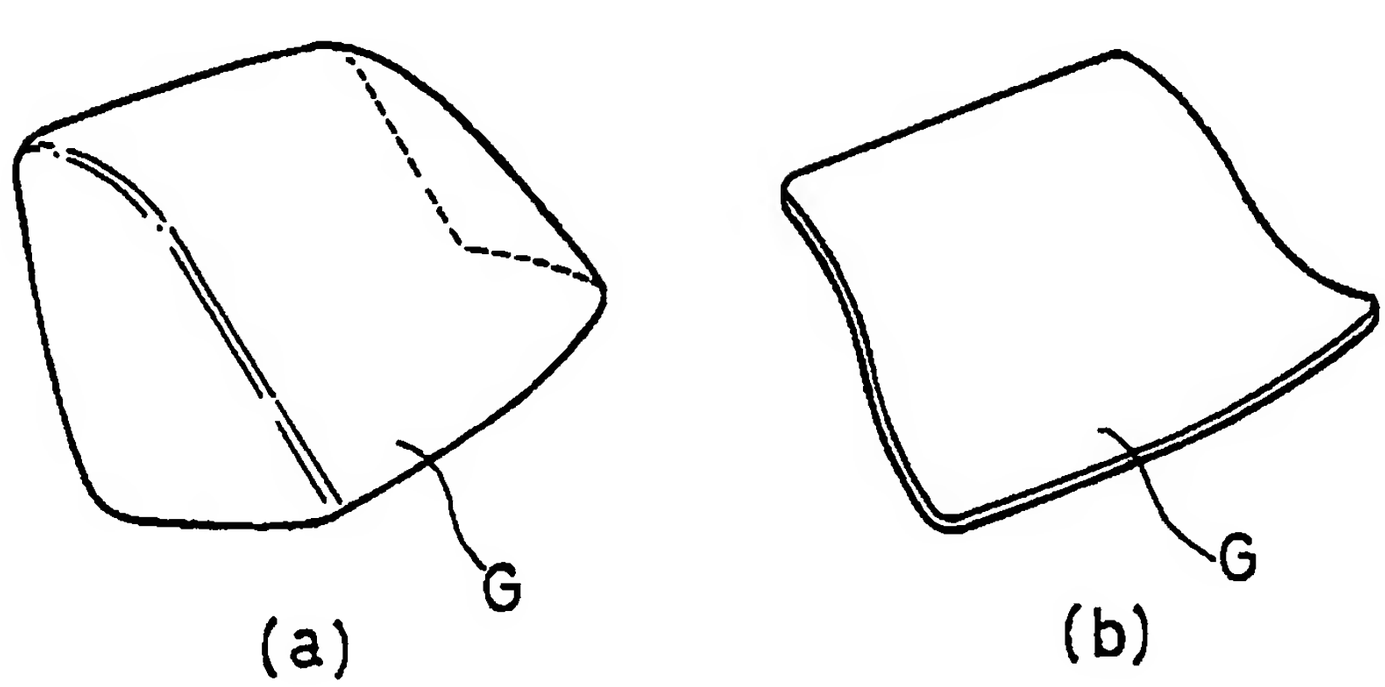
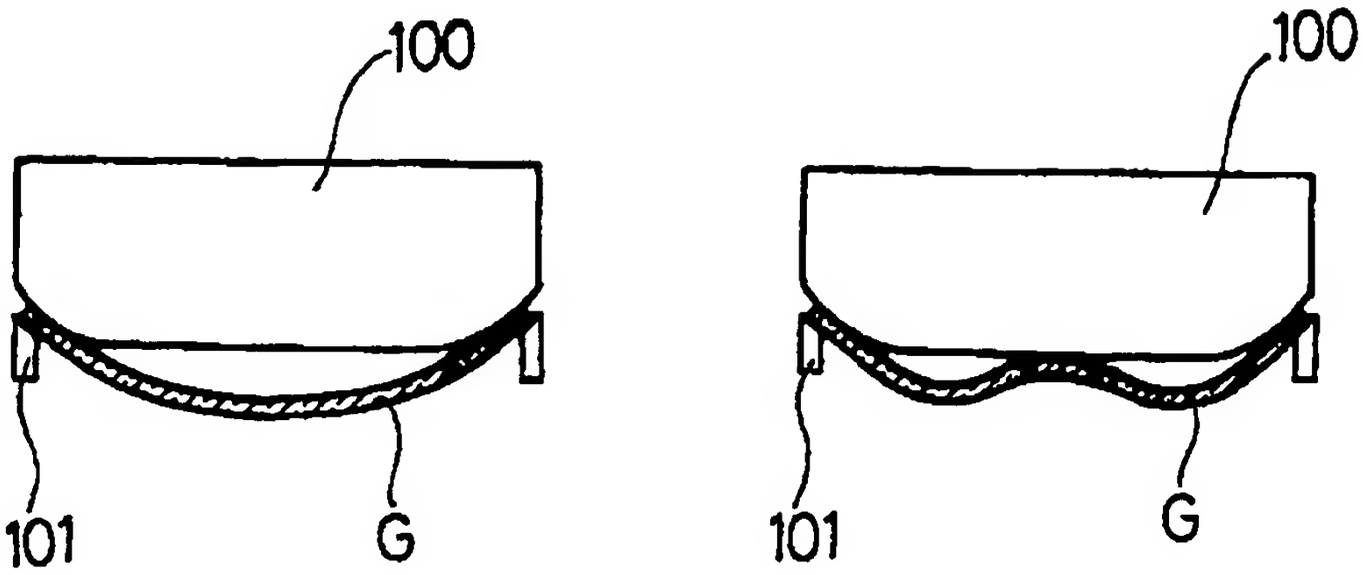
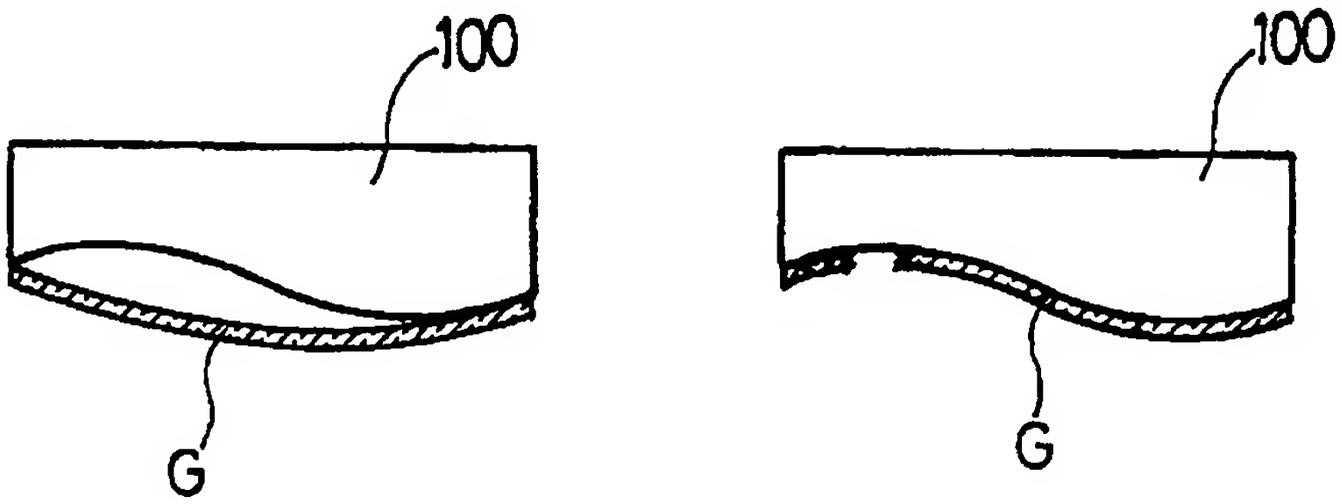


FIG.8



(a) (b)

FIG.9



(a) (b)